Faculty of Resource Science and Technology

GROWTH PATTERNS AND CONTROL OF *DEIFFENBACHIA SEGUINE* (JACQ) SCHOTT

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Declaration

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.

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LIST OF ABBREVIATIONS

m	**:**	**Meter**
cm	**:**	**Centimeter**
SLA	**:**	**Specific leaf area**
LAR	**:**	**Leaf area ratio**
LA	**:**	**Leaf area**
LWR	**:**	**Leaf weight ratio**
PWR	**:**	**Petiole weight ratio**
SWR	**:**	**Stem weight ratio**
RWR	**:**	**Root weight ratio**
L	**:**	**Litre**
ha	**:**	**Hectare**

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ABSTRACT

The study was conducted to determine the growth pattern and distribution of biomass allocation of *Dieffenbachia seguine* (Jacq.) Schott in natural habitat at Kampung Terasi, Sadong Jaya Sarawak. The main parts of the plant were contributed to the biomass dry matter composed of stems, leaves, petioles and roots brought to the External Laboratory at Faculty of Resource Science and Technology University Malaysia Sarawak. Five quadrats were constructed in both open area and under tree canopy shading area. The total number of plants and total number of leaves in the open area was recorded as the highest compared to the under tree canopy shading area. The leaf area (LA) was recorded highest at under tree canopy shading area compared to the open area. While, the specific leaf area (SLA) and leaf area ratio (LAR) also recorded as highest in the under tree canopy shading area. The highest biomass partitioned was to the leaves and petiole in the shaded area while for open area the highest biomass partitioned to the roots and stems. *D. seguine* had a great potential for mass production of planting materials through stem cutting. The control of *D. seguine* with six different treatments of herbicide did not show 100% desiccation effects. The treatment of combination of 2,4-D dimethylamine with Metsulfuron methyl was recorded more effective to control *D. seguine*.

Keywords: *Dieffenbachia seguine,* growth pattern, biomass allocation, herbicides

ABSTRAK

Kajian tentang corak pertumbuhan dan corak peruntukan biojisim *Dieffenbachia seguine* (Jacq.) Schott telah dijalankan di Kampung Terasi, Sadong Jaya Sarawak. Bahagian-bahagian utama tumbuhan yang menyumbang kepada bahan kering biojisim yang terdiri daripada batang, daun, tangkai daun dan akar telah di bawa ke Makmal Luar di Fakulti Sains Sumber dan Teknologi Universiti Malaysia Sarawak. Lima quadrat telah di bina di kedua-dua kawasan terbuka dan kawasan di bawah teduhan pokok. Jumlah keseluruhan tumbuhan dan jumlah daun di kawasan terbuka lebih banyak berbanding kawasan dibawah teduhan pokok. LA, SLA dan LAR telah merekodkan catatan yang tinggi di kawasan bawah teduhan pokok berbanding dengan kawasan terbuka. Biojisim tertinggi adalah daripada daun dan tangkai daun di kawasan bawah teduhan pokok manakala bagi kawasan terbuka biomass tertinggi adalah daripada akar dan batang. *D. seguine* mempunyai potensi yang besar untuk tumbesaran melalui keratan batang. Kawalan *D. seguine* dengan enam rawatan yang berbeza daripada racun rumpai tidak menunjukkan 100% kesan kerosakkan. Rawatan gabungan 2,4-D dimethylamine dengan Metsulfuron metil dicatatkan lebih berkesan untuk mengawal *D. seguine*.

Kata kunci: Dieffenbachia seguine, corak pertumbuhan, corak biojisim, racun rumpai.

CHAPTER 1

INTRODUCTION

Malaysia achieved independent 55 years ago and agriculture has provided mainly to its gross domestic product (GDP). According to Rahman (2012), currently about 11% of Malaysia's GDP are from agriculture. The agriculture sector gives a primary role in Malaysia's economic development such as contribute to employment, uplifting agriculture incomes and provide national food security. The agriculture in Malaysia is a broad sector, including industrial crops such as oil palm and rubber, food and cash crops such as paddy and livestock.

Weeds are a main element or problem in plantation and agriculture system. According to the Mohamad *et al.* (2010), the distribution of weeds consists of combination of grasses, sedges, and broadleaves which frequently changes based on the crop growth level which provide specific climatic and environmental conditions fitting for specific weed growth. The shade prepare by the oil palm canopy affects the nature of weed distribution, and grass species tend to dominate as the oil palms get bigger (Wan Mohamed, as cited in Mohamad *et al.,* 2010). The outcomes of weeds on oil palm are challenging to evaluate due to their long economic life (i.e. 20-30 years) but they can influence the growth of crops or cause yield losses (Kuan, as cited in Mohamad *et al.*, 2010). The higher abundance of weed, the more is the nutrient depletion of the soil and the more is their competition with crop plants. Before this there are weeds that not classified as a weed, but now on classified. *Dieffenbachia seguine* (Jacq.) Schott is a cultivated as an ornamental plant in temperate shade gardens and as a potted house plant but it can be as weed when growth in plantation and agriculture system as an unwanted plant.

Dieffenbachia seguine (Jacq.) Schott is a member of the family Araceae, subfamily Aroideae and tribe *Dieffenbachia*. Origin of the *Dieffenbachia* genus is in shady, moist lowlands of tropical America, which is from southern Mexico through Central America to Northern South America and Brazil also it is native to several Caribbean Islands including Puerto Rico (Barnes & Fox, as cited in Cao, 2003). The name of this genus was given by J. F. Dieffenbach, a famous German physician and botanist. The particular plant was first identified in the genus Arum but was subsequently changed to the genus Caladium. In 1829, Schott defined the genus *Dieffenbachia* to compliment Dr. Dieffenbach (Barnes & Fox, as cited in Cao, 2003). More than ten equivalent names are identified with it, among which are : *Arum seguine* Jacq., *Caladium maculatum* Lodd. et al., *Dieffenbachia amoena* hort., *Dieffenbachia baraquiniana* Verschaff. & Lem, *Dieffenbachia exotica* hort., *Dieffenbachia lineata* K. Koch & C. D. Bouché, *Dieffenbachia lingulata* Schott, *Dieffenbachia maculata* (Lodd. et al.) G. Don, and *Dieffenbachia picta* Schott. It is regularly called dumb cane, dumb plant, mother-in-law plant, zebra plant or spotted *Dieffenbachia*.

1.1 PROBLEM STATEMENT

Generally, *Dieffenbachia seguine* as an ornamental plant and become weeds when growth in agriculture and plantation system because it is unwanted plant that can reduce the quantity and quality the crop products. Besides those weeds also influences the maturation of crops or cause production losses. The combination between herbicides should be considered in term of control weed because mixing herbicides increase the range of weed species to be controlled. The uses of herbicides to control weeds also can give problem in conditions of economic because of their expensive costs.

1.2 OBJECTIVES

The objectives of this study were as follows:

- To determine the growth pattern and biomass allocation pattern of *Dieffenbachia seguine* (Jacq.) Schott in natural habitat.
- To determine the potential for mass production of planting materials through stem cutting
- To determine the effectiveness control of various herbicides and combination of herbicides.

CHAPTER 2

LITERETURE REVIEW

2.1 Morphological of *Dieffenbachia seguine* (Jacq.) Schott

D. seguine is an erect perennial herb, able to grow up to 1-2 m high or more than that with a moderately stout caudexes that is clearly ringed stem and accumbent, the lower part routing at the nodes. The leaves are 15-40 cm long, simple, alternate, with narrowly oblong-ovate blades with an acute-acuminate apex that sometimes show up as a short, fine and almost thread-like aciculums. Decoration on the leaf surface is formed by patterns of many irregular yellowish or cream-green spots or white spots and flecks. The leaf base is shallowly cordate with rounded lobes, midrib is prominent and lateral veins curved-ascending. The petiole is 30 cm long, grooved and winged from the base to beyond the halfway point. Flowers are many, borne tightly packed in a cylindrical spadix usually 14-17 cm long with an oblong-lanceolate, persistent, greenish or white spathe 15-25 cm long. The fruit is a globose red-orange berry but infrequently formed in cultivation.

2.2 Biomass allocation

The biomass allocation pattern of the plant component is different based on species, ontogeny, and environment (Hendrik and Oscar, 2000). The word allocation will use to establish the amount of biomass that exists in the numerous part with respect to the total plant mass.

According to the Hendrick and Lawren (2012), how plants partition newly fixed carbohydrates among organs and biochemical fractions is likely to be as valuable to whole plant performance and ecology as photosynthesis itself. Carbohydrates may be employed to fuel leaf respiration, or can be stored as starch or fructans for later use. Alternatively, they can be transported elsewhere in the plant to be used to promote vegetative growth, maintenance processes, and/or reproduction.

According to the Wang and Feng (2004), in low amount of light, plants increase light interception by means of improved biomass allocation to leaves and the leaves were wider and bigger, thin leaves with high specific leaf area (SLA), contributing to a high leaf area ratio (LAR). At the high quantity of light, plants decreased transpiration losses and increased carbon gain by forming low-sized, compact leaves with a low SLA, leading to a low LAR and leaf area (LA) to root mass ratio (Wang and Feng, 2004).

It has been known for long that allocation to roots will be higher with decreasing nutrient or water availability (Brenchley; Maximov, as cited in Hendrick & Oscar, 1999) and that allocation to shoots increases with decreasing irradiance (Shirley, as cited in Hendrick & Oscar, 1999). Moreover, when nutrients are re-supplied after being withheld for some time, shoot root ratios return to the values of the plants that have received nutrients all the time (Brouwer, as cited in Hendrick & Oscar, 1999).

2.3 Herbicides control at natural habitat

Herbicide is a chemical or biological element which kills plants or prevents their growth. Herbicide is a pesticide specifically for controlling plants, just like an insecticide is a pesticide used to control insects. The practices of herbicide are an efficient approach for controlling weeds. Herbicides should primarily be utilized in conjunction with one or more other control methods, such as mechanical control, biological agent, cultivation, cutting or mulching. Herbicides can greatly increase the effects of these alternate techniques. Herbicides can be really effective and have a lower side effect on the surroundings. Efficient usage of herbicides needs to recognize the principles of using herbicides, which are the target weed, the herbicide, and the site conditions (Chemical weed control, 2013).

According to Chemical weed control (2013), broadleaf weed control generally uses paraquat as a weed killer. It can respond fast, non-selective compound, that damage green plant tissue on contact and by translocation within the plant. Paraquat can be tank mixed and combine with other herbicides to get the more effective and more consistent burn down result than with paraquate alone (Chemical Weed Control, 2013).

Illustrated that if you prefer to control the weeds by using chemical herbicide, 2,4-D amine, or a combination of the two chemical herbicides is the effective way for most of the broadleaf weeds. 2,4-D amine must be taken up by the plant leaves and transfer to the roots. The herbicides should be applied when the weeds are actively growing and healthy. Furthermore hot, dry weather causes the weeds to become dormant and they will not be effectively controlled (Weed Control, n.d.).

According to Vanhala *et al*. (2004), the outcome of weed control treatments on weeds can be assessed by using visual observation. A rating system that is clear and simple must be using in order to be consistently. Several systems have been developed by weed scientist for visual assessment (Shaw and Swanson, 1952; Willard, 1958; Frans *et al*., 1986; Gnegy, 1991; Anonymous, 1994 as cited in Vanhala *et al*., 2004). The most widely spread scale uses a 0 to 100 rating which is then used directly as percentages in analyses of variance.

CHAPTER 3

MATERIALS AND METHODS

3.1 Location and study area

The research was conducted at Kampung Terasi Sadong Jaya, Sarawak. It involved ten quadrates constructed in open area and under tree canopy shading area. The main parts of the plant were contributed to the biomass dry matter composed of stems, leaves, petioles and roots brought to the External Laboratory at Faculty of Resource Science and Technology University Malaysia Sarawak.

3.2 Growth pattern and biomass allocation pattern of *D. seguine*

Five quadrats 1m x 1m were organized in both open area and under tree canopy shading area. All the *D. seguine* species in the quadrats were calculated and divided according to vegetative part to measure the dry weight of leaves, roots, petioles, and stems. The separated vegetative parts were counted from every quadrats. AT Delta-T Scan (Delta-T devices LTD, England) was used to measure the leaf area. All separated vegetative parts were dried on 60^{o} C for 8 days for determination of the total dry weight, leaf weight ratio (LWR), petiole weight ratio (PWR), stem weight ratio (SWR) and root weight ratio (RWR).The biomass allocation pattern was interpreted using the method defined by Peterson and Flint (1983):

1. Leaf weight ratio (LWR) = L/W (g/g)
2. Stem weight ratio (SWR) = Rh/W (g/g)
3. Root weight ratio (RWR) = R/W (g/g)
4. Specific leaf area (SLA) = LA/L (cm^2/g)
5. Stolon weight ratio (SWR) = S/W (g/g)
6. Leaf area ratio (LAR) = LA/W (cm^2/g)

Whereby,

W = whole plant dry weight; L = leaf dry weight; P = petiole dry weight; R = root dry weight; S = stem dry weight; LA = Leaf area.

The analysis of data will be subject to T-test analysis.

3.3 Effects of herbicides on control of *D. seguine*

The study were used of four types of herbicides, which are 2,4-D dimethylamine 48% a.i (D-Amine 480), Metsulfuron methyl 20% a.i (Elike 20 WG), Paraquat dichloride 13.0 % (ZA Paraquat), and Glyphosate–isopropylammonium 41% a.i (bm Glyphosate 41). Sum of six treatments was involved in the study, which are 2,4-D dimethylamine, Metsulfuron methyl and Paraquat dichloride were used as a single treatment and another three herbicide mixtures such as of a combination of 2,4-D dimethylamine with Metsulfuron methyl, the combination of Paraquat dichloride with Metsulfuron methyl, and the combination of Metsulfuron methyl with Glyphosate-isopropylammonium. The rates of application were 1.7L/ha for 2,4-D dimethylamine, 50g/ha for Metsulfuron methyl, 2.0L/ha for Glyphosate-isopropylammonium and 5.4L/ha for Paraquat dichloride.

Quadrats of 2 m x 2 m were randomly constructed for herbicides spraying. Each quadrats as a one replicates and every treatment consists of three replicates. The effect of weed control treatments on *D. seguine* was reported weekly through visually assessment in percentage of control for six weeks (0% indicates no weed reduction or injury and 100% for complete destruction) (Table 1).

Table 1: A linear rating scale that can be used to assess weed control or crop damage. (Modified from Frans *et al*., as cited in Vanhala *et al*., 2004).

Rating Weed Control	Crop Damage
0 No weed control	No crop reduction or injury
10 Very poor weed control	Slight crop discoloration or stunting
20 Poor weed control	Some crop discoloration, stunting, or stunt loss
30 Poor to deficient weed control	Crop injury more pronounced, but not lasting
40 Deficient weed control	Moderate injury, crop usually recovers
50 Deficient to moderate weed control	Crop injury more lasting, recovery doubtful
60 Moderate weed control	Lasting crop injury, no recovery
70 Weed control somewhat less than satisfactory	Heavy crop injury and stand loss
80 Satisfactory to good weed control	Crop nearly destroyed - A few surviving plants
90 Very good to excellent weed control	Only occasional live crop plants left
100 Complete weed destruction	Complete crop destruction

3.4 Sprouting stem cuttings of different positions (growth stage) and cutting types

The stem nearest to the root considered to be the oldest while nearest to the shoots considered to be the youngest. The middle part of the entire stem considered as intermediate maturity. Stem at each development stage were cut into one node, two nodes, and three nodes. Each stem cutting type comprised of nine stems cuttings. All stems were left to sprout in the moist sand that was satiated in a shallow tray. Watering was done daily. The number of sprouting was recorded every week for a 6 week period.